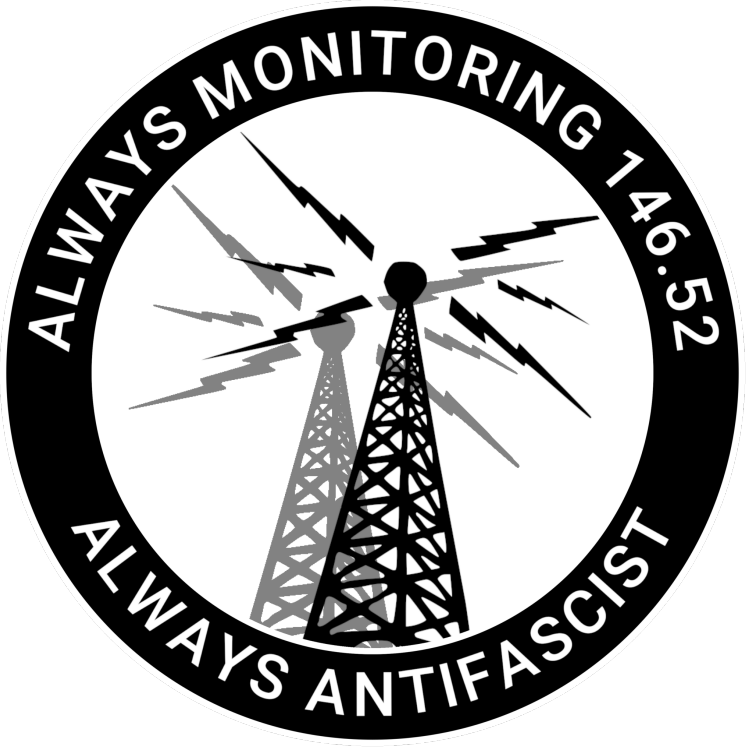
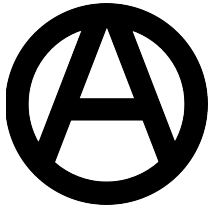


73 ..

“For an Anarchist Radio Relay League v0.25.10.7”

https://anarchistrrl.noblogs.org

October 2025



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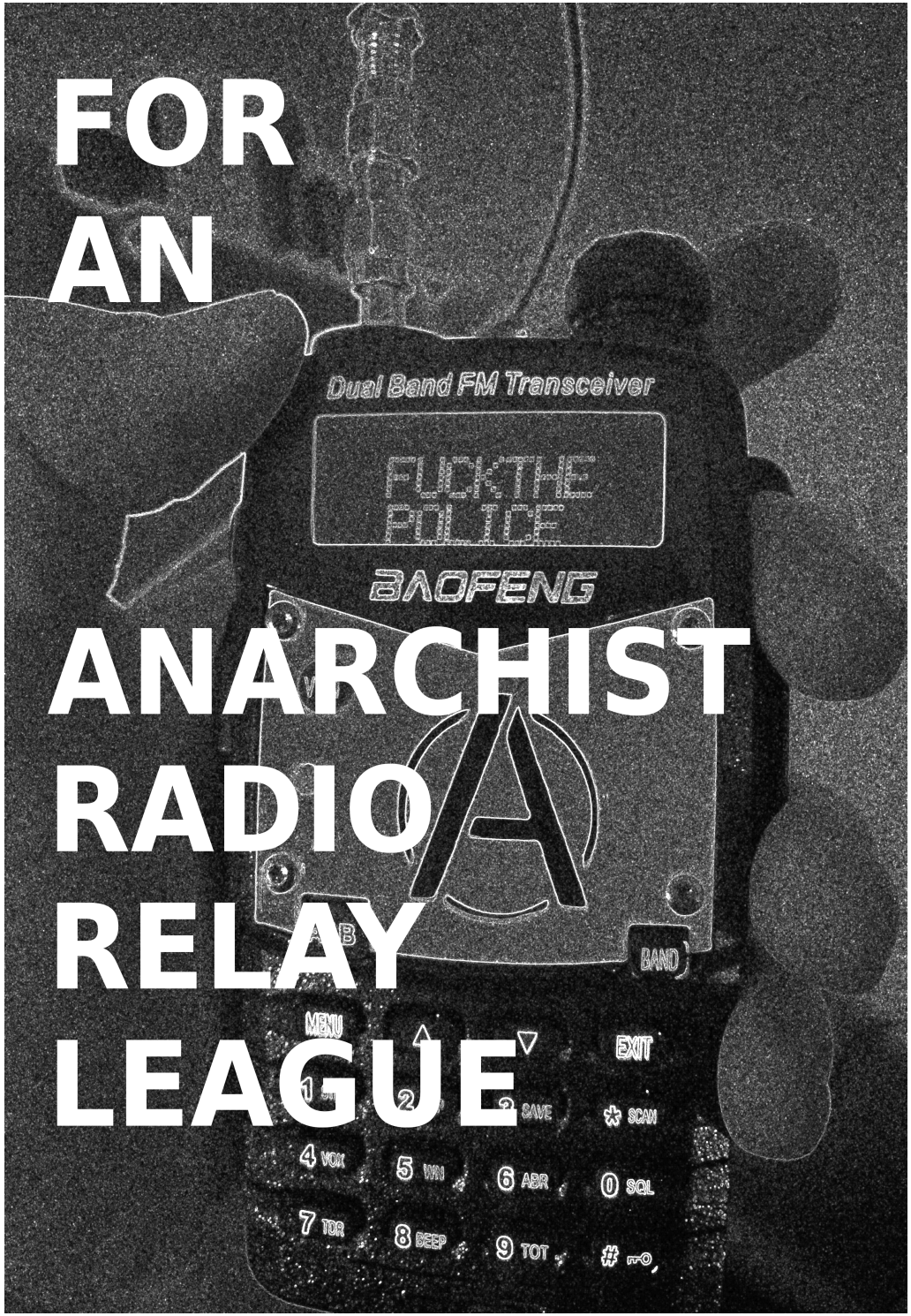

better digital modes for that. If you want to use Morse Code, *learn Morse Code!*

In Conclusion I think I've run out of things to write for now. Hopefully this has been useful, or at least interesting. I'm not sure what I was aiming for, but I think this is longer than I had intended and there's still so much that could be written, so I'll just cut it off. Get out there and play radio!

Further Research – Look up these call signs to get deeper info on these topics.
HB9BLA, K6ARK, KB9VBR, KE0OG, KI6NAZ, KJ4YZI, KM9G, M0MCX, VK3FUR, VU2NSB,

(NOTE: The above individuals don't necessarily know us and we don't necessarily personally know them. We do not necessarily endorse any of their political or philosophical ideals or tendencies, nor do they necessarily endorse ours. They are on this list purely because they have made accessible online a good amount of information about the technical aspects of amateur radio.)

Introduction

We could spend months on this document, adding little pieces of information, organizing it all logically, and checking to make sure that each sentence is accurate. But to be honest, we would prefer not to. Our goal is to encourage you, dear comrade, to learn about amateur radio and consider developing it as a skill and a tool you can use to help build the leaderless, borderless, and just world that we all want.

The information in this zine is very US-centric because most of us have lived in the so-called "United States" our entire lives and it's the cultural and legal environment that we're most familiar with. If you reside outside the imaginary walls that separate this country from the rest of the world, you should research your local laws and customs regarding radio transmission so that you can know what you're getting into.

This is not meant to be a complete technical manual about the science and art of radio, nor is it meant to be a quick how-to guide for your affinity group to set up emergency comms training. The former can be found in abundance, and the latter can be so specific depending on your situation that it would be impossible for us to write about with any authority. Instead, it might help to consider the contents of this zine "food for thought."

Radio is an incredibly deep topic. It can be as simple or as complex as you want or need it to be. As such, talking about it involves a lot of jargon and acronyms which we'll do our best to decipher for you as they come up in the text.

Amateur Radio is a Commons, and one that we think should be used and defended lest we lose it altogether.

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> or instruments which had an ordinal number as part of their meaning, e.g., the third meeting was "TRIDENT". Joseph Stalin, whose last name means "man of steel", was given the name "GLYPTIC", meaning "an image carved out of stone".

What about speaking in code? So, the FCC rules say that you have to identify yourself in English every 10 minutes while transmitting *if you're transmitting on the ham bands*. We feel like we've harped on the FCC shit quite enough now.

If you and your comrades speak a language other than English, and the cops and fascists don't know it, and it's safe for you to use in your situation, then use it. Some people have suggested that we learn Esperanto to obfuscate our transmissions. It's an easy language to learn. In some ways it's easier, and definitely cheaper, to learn Esperanto than it is to figure out how to set up digital radio modes. And I personally doubt the cops would ever bother learning it. And if they do learn it, then you can start using code words in Esperanto just to piss them off!

What about Morse Code? Morse Code is great! Hams usually call it CW, which stands for Continuous Wave. CW is the most efficient mode there is. You can get a signal farther with less power and less equipment than any other mode, and it takes up less bandwidth than any other mode. Software CW decoders do exist. However, humans are far better at interpreting CW sent by another human in real time than a computer probably ever will be. If you want to send messages over radio via computer, there are

What about code names? Sure. Have code names. Why not? It's a common thing on CB. If you're a licensed ham speaking with other licensed hams you have to use your callsign. But if you're at an action or you're just playing around, everything should be fine as long as you're not causing interference for other people. Here's a thing from Wikipedia:

> During World War I, names common to the Allies referring to nations, cities, geographical features, military units, military operations, diplomatic meetings, places, and individual persons were agreed upon, adapting pre-war naming procedures in use by the governments concerned. In the British case names were administered and controlled by the Inter Services Security Board (ISSB) staffed by the War Office.[1] This procedure was coordinated with the United States when America entered the war. Random lists of names were issued to users in alphabetical blocks of ten words and were selected as required. Words became available for re-use after six months and unused allocations could be reassigned at discretion and according to need. Judicious selection from the available allocation could result in clever meanings and result in an aptronym or backronym, although policy was to select words that had no obviously deducible connection with what they were supposed to be concealing. Those for the major conference meetings had a partial naming sequence referring to devices

Version 0.24.1.1: When this zine was first released in late 2020, the author acted mostly alone. Hence several instances of “I” and “me”. Well, the Anarchist Radio Relay League is now a thing that actually exists. It’s no longer a “me” or an “I”, but a “we” and “us” – a collective of anarchist hams and radio enthusiasts. We’ve taught each other a lot about radio, and a fair amount has happened in the last 3 years. So we decided to put together a new version. Nothing has been removed, but quite a bit has been added. Enjoy.

Bootlickers

Traditionally, the value of amateur radio to the government of the so-called "United States of America", and the reason it continues to be tolerated and regulated today, has been that hams* could provide vital communication services in the event of an emergency. If the Internet and phone systems were to go down because of an attack by a nation state, domestic anti-government forces, or a natural disaster, amateur radio stations would still work because they don't rely on a centralized infrastructure to operate. This provides an opportunity, theoretically, for the government to regain control and rebuild the State. Hence the end of Terminator 3, if you've been unfortunate enough to witness that train wreck of a movie.

***Ham**: a term for an amateur radio operator

The rest of us

However, in a time when the United States government is fighting tooth and nail for the preservation of its own legitimacy while simultaneously eviscerating community services by way of privatization (Health Care, Postal Service, Public Land, Public schools, you name it), it is as important for the anti-authoritarian Working Class to learn about the science and art of radio communication as it is to learn how to grow food and shoot straight. (read "Factories, Fields, and the Firearms to Defend Them" by Hybachi LeMar)

In fact, in October of 2020, Ajit Pai's* FCC** ordered amateur access to the 3.5GHz band to be "sunset" (http://www.arrl.org/news/fcc-orders-amateur-access-to-3-5-ghz-band-to-sunset) so that the frequency space can be sold to private companies to expand the new 5G mobile network. While this isn't exactly disastrous for anyone other than a specific sub-set of Hams***, it is par for the course for this early half of the 21st Century that the government would sell off public property to the highest bidder so that private companies can sell it back to "Consumers" and lock poor people out of access to something as ubiquitous as air or water. Sound familiar? (https://iaffaiorg.wordpress.com/2020/10/11/skills-for-revolutionary-survival-5-communications-equipment-for-rebels/)

*__Ajit Pai__: Chairman of the FCC appointed by Donald Trump **__FCC__: Federal Communications Commission, the governing body in the United States which regulates communications by radio, television, wire, satellite, and

If you have read this far, it's probably up to you to do these things. Just like healthcare, education, cooking, running, fighting, and reading Das Kapital*, there are things that a lot of people just can't do. So we rely on others to support us by doing those things, and in turn we support them by doing the things we *can* do. That's called mutual aid, a.k.a. "being a human." Radio is a deep topic with a lot of jargon and concepts that some people will simply never have the time, inclination, or aptitude to learn and understand. Be a good comrade and be there for those people.

*It's me. I'm the one who can't read Das Kapital. I'm not doing it.

Disaster Relief efforts may require communication and coordination between cities, neighborhoods, households, caravans bringing relief supplies, or caravans leaving an effected area. Your disabled and elderly or injured comrades should be able to contact you and/or emergency services in case they are unable to leave their homes, so that you can figure out a way to either help them or find someone who can.

What about an EMP? An EMP is an Electromagnetic Pulse. It can fuck up your electronics. We're not going to go much deeper into the topic ~~because it's honestly not that likely to happen. If you're really worried about it, wrap one of your radios in aluminum foil and save it for when/if that happens~~. Hi. 2023 here. Obviously, things have happened since this was first written. We encourage you to assess this risk on your own, and to be weary of snake oil salesmen.

> Placing 146.52 MHz , 52.525, 223.5, 446.0 and 1294.5 MHz in your Scanner would help.
>
> Priority transmissions should begin with the LiTZ signal. (LONG TONE ZERO) CQ-like calls (to see who is out there) should not take place until four minutes after the hour."

(https://tcares.net/the-wilderness-protocol/)

This is an excellent thing to keep in mind for situations that involve anyone in your community, but you may want to develop your own "wilderness protocol" equivalent for situations that effect only your affinity group by perhaps using a different frequency and/or different times of day.

"Preparedness" is another incredibly deep topic that, in a general sense, involves developing contingencies for everything including food, shelter, transportation, clothing, care and healing, sanitation, entertainment and communication all based on a "threat model". Depending on where you live, you may need to respond differently to things like (in alphabetical order) blizzards, disease outbreaks, earthquakes, fascist takeovers, forest fires, floods, government collapse (fingers crossed), heatwaves, hurricanes, isolation, personal injury, tornadoes, typhoons, war, and plenty of other possibilities of late-stage capitalism and climate collapse. We suggest that you look at both your natural and your cultural landscape to start making a plan, gather what you need, and train yourself/affinity group/friends/family/community BEFORE your threat model comes to pass.

cable. This agency and people like Mark Zuckerburg are why the Internet sucks. ***Actually, one of the major amateur radio projects on the 3.5GHz spectrum is called the Amateur Radio Emergency Data Network (AREDN) which would essentially give people Internet and phone access in the event of a disaster and was in fact useful in the forest fires of 2019 and 2020. 5.8GHz seems to be more popular for that, but the issue of 3.5GHz being sold off is far from being as trivial as we described it above.

We own the airwaves

Maybe you got the gist of what we meant when we said the government was selling off "public property" in the form of a radio frequency band, but maybe you didn't. It's kinda complicated, but it's kinda not. we'll do our best. Here goes.

First off, here's the Wikipedia definition of "Radio Waves":

> Radio waves are a type of electromagnetic radiation with wavelengths in the electromagnetic spectrum longer than infrared light. Radio waves have frequencies as high as 300 gigahertz (GHz) to as low as 30 hertz (Hz). At 300 GHz, the corresponding wavelength is 1 mm (shorter than a grain of rice); at 30 Hz the corresponding wavelength is 10,000 km (longer than the radius of the Earth). Like all other electromagnetic waves, radio waves travel at the speed of light in

vacuum (and close to the speed of light in the Earth's atmosphere, which acts as the transmission media for the vast majority of terrestrial use). Radio waves are generated by charged particles undergoing acceleration, such as time-varying electric currents. Naturally occurring radio waves are emitted by lightning and astronomical objects. Radio waves are generated artificially by transmitters and received by radio receivers, using antennas. Radio waves are very widely used in modern technology for fixed and mobile radio communication, broadcasting, radar and radio navigation systems, communications satellites, wireless computer networks and many other applications. Different frequencies of radio waves have different propagation characteristics in the Earth's atmosphere; long waves can diffract around obstacles like mountains and follow the contour of the earth (ground waves), shorter waves can reflect off the ionosphere and return to earth beyond the horizon (skywaves), while much shorter wavelengths bend or diffract very little and travel on a line of sight, so their propagation distances are limited to the visual horizon.

Now, even we, some folks who felt bold enough to write a zine about it, can't claim to *fully* understand every single thing that's mentioned in those 2 paragraphs. But for now here's what we want you to walk away with: The electromagnetic spectrum, of which radio is a part, is

146.52 MHz with 52.525, 223.5, 446.0 and 1294.5 MHz serving as secondary frequencies. This system was conceived to facilitate communications between hams that were hiking or backpacking in uninhabited areas, outside repeater range. However, the Wilderness Protocol should not be viewed as something just for hikers. It can (and should) be used by everyone anywhere repeater coverage is unavailable. The protocol only becomes effective when many people use it.

The Wilderness Protocol recommends that those stations able to do so should monitor the primary (and secondary, if possible) frequency every three hours starting at:

7 AM, local time, for 5 minutes…
10 AM
1 PM
4 PM
7 PM
10 PM

Additionally, those stations that have sufficient power resources should monitor for 5 minutes starting at the top of every hour, or even continuously.

NOTE*** 146.52 MHz and 446.0 MHz are the national calling frequency NOTE***

Another interesting mesh networking project is called Reticulum. https://reticulum.network/index.html. Reticulum uses LoRa radios, but it’s also capable of using packet radio, WiFi, Ethernet, serial devices and TCP/UDP devices. Nothing on the Reticulum network is sent un-encrypted.

By learning and building now, we can build a base of knowledge, and an alternative infrastructure to compete with and overtake the capitalist communications infrastructure.

Disaster.radio. A disaster-resilient communications network powered by the sun. https://disaster.radio/ Red Strings and Maroons: EP16 Radio Communications 101 October 25, 2019 https://www.spreaker.com/user/10888075/ep16-radio-communications-101

Emcomm, preparedness, disaster relief

"Emcomm" is short for "Emergency Communication". It's a deep topic that, like many things in this zine, probably deserves its own dedicated zine, and I don't think I know enough to write about it quite yet. But the Wilderness Protocol is a good place to start.

> "The Wilderness Protocol is a suggestion that those outside of repeater range should monitor standard simplex channels at specific times in case others have Emergency or priority calls. The primary frequency is

governed by the laws of physics. It's like the Earth, Air, and Water. We can't create more of it. What we've got is what we've got.

What’s the point of Government?

There are a few tricks we can use to allow multiple people and devices to communicate on one frequency simultaneously. For instance, there's signal hopping. That's how cellphones and WiFi work. There's also TDMA (Time Division Multiple Access) which is what digital voice modes like DMR, D-STAR, and Yaesu System Fusion use. But even those have limitations if you want to, say, see how far you can send Morse Code the old fashioned way, using the same frequency as a WiFi router. It's not a terribly likely example of something anyone would want to do, but it may present problems of interference for anyone else using that frequency if, hypothetically, they did.

That, in theory, is the purpose of an agency like the FCC - to administer "rules of the road" for people doing work on the electromagnetic spectrum, so that baby monitors aren't causing interference with air traffic control systems, etc.

In practice, however, the amateur bands are largely self-policing. Not necessarily self-governing, mind you. But simply by social convention and generally agreed upon rules, there are parts of the amateur bands that are used for phone (voice) communications, and there are parts used

for digital modes, various rules of etiquette regarding conversation and use of the bands, etc.

The FCC does have rules governing what precisely can be transmitted over the ham bands. The main things are that you can't cuss/curse/swear, you can't transmit music, you have to identify yourself in English, and you can't "send messages intended to conceal their meaning" which basically means encryption. Now all of that is total white supremacist Euro-christian-centric horseshit in our opinion, but them's the rules. Let's build a better world, shall we?

The Bands

ELF:	"Extremely Low Frequency"	3-30 Hz,	Lightning, disturbances in Earth's electromagnetic field.
SLF:	"Super Low Frequency"	30-300 Hz	AC power grids, military submarine communication
ULF:	"Ultra Low Frequency"	300Hz-3kHz	seismology, mines, military(through earth)
VLF:	"Very Low Frequency"	3-30kHz	navigation, timekeeping, military(thru water)

logic as a casino slot machine? Do we make use of the same structures we have today, or do we build a new world in the shell of the old? (Obviously we can do both, but it's a zine about radio, so work with us here.)

We can send vital information, news, weather, instructions for medicine, food, construction, music, art, and memes, all over the airwaves.

There's a project called Disaster.radio that is linking 2.4GHz WiFi routers together with 915MHz LoRa radio transceivers powered by solar cells to provide low power, long range communication infrastructure that could survive natural disasters.

Since the first edition of this zine was written, LoRa devices have become quite well-known.* Possibly the most well known project is called Meshtastic, which is a firmware that can be loaded onto several models of development boards that combine LoRa radios with ESP32 WiFi/Bluetooth radios. Meshtastic turns these devices into off-grid encrypted messengers.
https://meshtastic.org

*Well-known enough to be mentioned in a paper called "Network Enabled Anarchy" (as if that's a bad thing) by the "Network Contagion Research Institute".
https://archive.org/details/ncri-white-paper-network-enabled-anarchy-14/ and
https://www.youtube.com/watch?v=EAQI2ZSmxPU
("Rutgers University Confirmed: Meshtastic and LoRa are dangerous" by Andreas Spiess)

In 1916, with ARRL membership nearing a thousand, Maxim set up six trunk lines of relay stations, both east–west and north–south, and individual managers were appointed. Messages were now being relayed over longer and longer distances, and in February 1917 a message was sent from New York to Los Angeles and an answer received in one hour and twenty minutes.

Today, the ARRL is essentially the only organization that lobbies the government on behalf of radio amateurs. Other countries have very similar organizations that perform a very similar function.

An Anarchist Radio Relay League, we think, would have a similar function to the *original* ARRL, but in the spirit of mutual aid and solidarity, and with an explicit anticapitalist and anti authoritarian orientation.

This has the potential to take many forms.

Our initial thoughts are that coordination of non-state mutual aid efforts could be done via radio to some degree. Disaster relief drop-offs, strikes, blockades, etc.

World Building

Imagine when the cops, prisons, bosses and borders are all gone. The revolution is over. We've won. How do we share information with each other over long distances? Do we use the same data silos designed to spy on every single person on earth and sell them shit they don't need? Do we use the same software designed with the same captivating

LF:	"Low Freq."	30-300kHz	broadcasting
MF:	"Medium Frequency"	300kHz-3MHz	AM broadcasting, navigation, maritime ship-to-shore, air traffic control
HF:	"High Frequency"	3-30MHz	"shortwave radio" international broadcasts, timekeeping, weather, amateur radio, and Citizens Band (CB)
VHF:	"Very High Frequency"	30-300MHz	digital audio, FM radio broadcast, TV broadcast,

The 2-meter amateur radio band is a portion of the VHF radio spectrum, comprising frequencies stretching from 144 MHz to 148 MHz in International Telecommunication Union (ITU) Regions 2 (North and South America plus Hawaii) and 3 (Asia and Oceania) and from 144 MHz to 146 MHz in ITU Region 1 (Europe, Africa, and Russia). The license privileges of amateur radio operators include the use of frequencies within this band for telecommunication,

> usually conducted locally within a range of about 100 miles (160 km). ~ Wikipedia

UHF: "Ultra High Frequency" 300MHz-3GHz, TV broadcast, cell phones, satellite communication, GPS, Wi-Fi, Bluetooth, walkie-talkies, cordless phones, garage door openers, car door locks.

> The 70-centimeter or 440 MHz band is a portion of the UHF radio spectrum internationally allocated to amateur radio and amateur satellite use. The ITU amateur radio allocation is from 430 to 440 MHz; however, some countries, such as the United States, allocate hams 420 to 450 MHz. Depending the country the band is shared with other radio services (in United States with government radar systems such as PAVE PAWS). ~ Wikipedia

SHF: "Super High Frequency" 3 GHz - 30 GHz, Radar transmitters, wireless LANs, satellite communication, microwave radio relay links, short range terrestrial data links, industrial microwave heating, medical diathermy, microwave hyperthermy to treat cancer, and microwave ovens.

EHF: "Extremely High Frequency" 30GHz-300GHz, military fire-control radar, airport security scanners, short range wireless networks, scientific research, 5G cellphone networks.

A secret 0th question is: How many watts do I really need to make the contacts I need to make? Why use 100 watts when 10 watts would do?

It helps to understand these concepts. But when the math butts up against reality, a lot of this becomes intuition. Practice makes good-enough.

Portable solar radio check list:

	Radio (incl. mic, key, digital interface, computer)		Battery
	Antenna		Power Cables
	Coax cable(plus coax adapters)		Solar Charge Controller
	Logging tool (pen and paper or pc/phone/tablet)		Solar Panel

Tip: As a radio operator, you'll probably need to make your own power cables at some point. Anderson Power Poles are a good power connector to use because they are genderless (no "male/female" or "plug/socket", they're all the same), which just allows various pieces of equipment to interoperate easily.

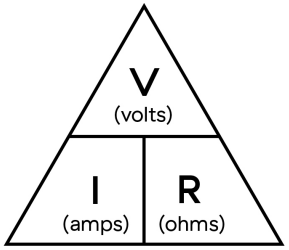
What is an Anarchist Radio Relay League?

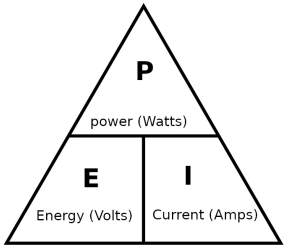
The American Radio Relay League was founded by Hiram Percy Maxim in 1914 for the purpose of organizing radio operators to relay messages beyond an individual station's range by having Hams in the middle copying messages and relaying them to the destination operator.

Standardizing on 12 volts also makes it easy to add solar panels to your system to create a self-contained autonomous radio station. But duty cycle also factors into this. Learn about the solar panel and what it can realistically provide (not just ideally) and for how long.

Ohm's Law: Electromotive force (Volts) = Current (Amps) × Resistance (Ohms). V=I×R

Watt's Law: Power (Watts) = Electromotive force (Volts) × Current (Amps). P=E×I





The questions you are trying to answer with all this math are:

1. How much current does the system draw during use?

2. How long do I plan to operate?

3. Based on 1 and 2, how much battery capacity do I need?

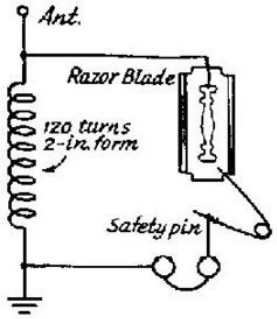
4. Based on 1, 2, and 3, how big of a solar panel do I need? (in Watts)

THF: "Tremeandously High Frequency" 0.3 THz to 30 THz (TeraHerz)

> Terahertz radiation occupies a middle ground between microwaves and infrared light waves known as the "terahertz gap", where technology for its generation and manipulation is in its infancy. The generation and modulation of electromagnetic waves in this frequency range ceases to be possible by the conventional electronic devices used to generate radio waves and microwaves, requiring the development of new devices and techniques. ~ Wikipedia

Why get a license?

Baofeng and other cheap VHF/UHF radios. Amateur radio is hella cheap to get into these days, compared to how it used to be. So why bother getting licensed? Why not be a pirate on the airwaves broadcasting your radical anarchist propaganda from a rooftop with a $25 Baofeng radio?



Fox Hole Radio

First of all, an anarchist FM or AM radio station that anyone could tune in and listen to in their cars or on hand-wound copper coil foxhole radios would be amazing and beautiful, and you should figure out how to make that happen if you are so inclined. But

Broadcast radio isn't the same thing as Ham radio and it's not really what we're talking about here. (Check out a book called “Seizing the Airwaves: A free radio handbook” for more information about this topic.)

Well, there's more to radio, tactically and technically, than a cheap handheld radio such as the ubiquitous Baofeng can provide. Learning requires doing. And doing requires participating in a community structure which already exists, and learning from those community members about how to do what you want to do *as well as* learning and training with your affinity group.

An elder or mentor ham radio operator is often called an "Elmer". While your politics may not align with those of the Old White Dudes who probably make up the vast majority of the voices on your local repeaters, you can learn from them about radio communications. It is often said that if you are new to ham radio, and you find it difficult to strike up a conversation, to keep in mind that you already have something in common...you're all interested in radio.

There is a wealth of knowledge and information held within the minds of these reactionary bastards that no amount of Googling may ever provide you, or may never even occur to you to search for. You can do a lot on your own, but there's no replacement for making connections and consulting with elders. Besides, some of them are genuinely nice people.

supplies are generally still preferred to switching power supplies because they don’t generate nearly as much RFI. However, most switching power supplies really aren’t as bad as they used to be in the early days. PSUs purpose-built for ham radio can be pretty expensive. You can buy used, but you can also convert an old PC power supply for use in the shack.

- Portable operators lugged large sealed lead-acid batteries with them for years until fairly recently. The Lithium Iron Phosphate (LiFePo4) battery chemistry has changed that in recent years. A LiFePo4 battery supplies a consistent voltage until it runs out completely, has a life cycle of several thousand discharges, has greater power density than lead acid batteries, and it’s much safer than both lead acid and Lithium-ion battery chemistries.

For all of these options, it is important that your power source is able to supply *at least* the current (Amperage) drawn by the radio during transmit. When in doubt, use a bigger power supply, and put a fuse between *every* piece of equipment.

If you’re operating portable, Duty Cycle is another concept to familiarize yourself with. It’s a way of estimating how long you can operate with a given battery capacity (Amp hours) based on the amount of time you transmit vs. the amount of time you spend listening, and how much current the system draws in each of those states.

overdue, and a bad idea in the first place), there will soon be even more developments in digital radio modes. The Baud rate limit for digital ham radio modes in the US was removed on November 13, 2023. This means that hams will soon be able to take advantage of modern technology, and increase the speed of data communications over the air using our bandwidth limits rather than the artificially imposed measure of symbols-per-second.

Power to the Radios, Power to the People

Most ham radio equipment runs on 12 volts DC.

- Mobile rigs are often wired directly to a vehicle's 12v battery. There's usually a rubber grommet that allows the steering column to pass through the firewall. Most of the time you can squeeze the wire through this grommet without damaging anything, but sometimes you might have to drill a hole in the firewall. Auto parts stores carry something called a fuse tap, which allows you to tap the power lead off a fuse that's in use by another system while the engine is running, and turn the radio off when the engine is off. This prevents you from forgetting to turn off the radio and draining the battery. You can also just jam a wire in the fuse holder. That works fine too. Use a multimeter to track down a fuse that'll work for this. The process is pretty similar between I.C.E. vehicles and E.V.s, but much more information about this entire process can be found online.

- Base stations will often make use of a 12v regulated power supply (PSU) that plugs into the wall. Linear power

"In matters of boots, I refer to the authority of the bootmaker." ~Mikhael Bakunin

Ham radio is more than just talking to truckers with a walkie-talkie. Actually, it's barely even that. There are so many different things you can do, and different aspects of the hobby (that's how most people think of it) that hams can focus on:

- There are modes of communication that allow you to talk with people on the opposite side of the planet using less power than a half-dead AA battery. (FT8, JS8call, Fldigi)
- Hams were sending e-mail over ham radio networks before the Internet even existed. (Winlink) There still exist BBSes on various parts of the amateur bands. (Bulletin Board Systems, aka forums, before forums existed (forums are what we had before "social media" existed))
- Slow Scan Television (SSTV) allows you to transmit a full color image as a series of tones, and decode them on the receiving end using software on a computer or smartphone simply using a microphone.
- You can track the positions of airplanes and other vehicles using APRS (Automated Packet Reporting System)
- You can talk to people on the International Space Station.
- You can talk to people on Earth using the repeater on board the ISS and other amateur radio Low Earth Orbit satellites. (AMSAT)
    - There is also now an amateur radio satellite in Geostationary orbit called Es'hail 2 or QO-100 which became operational in 2018. Due to its position, it is accessible to all of Africa, the Middle East, Europe, western Asia and an eastern portion of South America. North America is not within view of QO-100.

Aside from simply being cool as hell, these are long distance communication systems that are ***decentralized and resilient.***

You may have heard of The Great Firewall of China. But in 2020 alone the governments of Bangladesh, Belarus, the Democratic Republic of Congo, Egypt, India, Indonesia, Iran, Iraq, Sudan, Myanmar and Zimbabwe have all, at one point or another, shut down or restricted Internet access within their borders. Just in 2020. All of that happened independently of whatever the CEOs of companies like Twitter, Facebook, Google and Cloudflare may have been feeling at the time. Reliance upon such services subjects us not only to the will of the State, but to the whims of private Capital as well.

In the so-called United States, whether it's "legal" or not, the police have the power to shut down cell towers in areas of protest and rebellion. This happened in Portland, Oregon in 2020 during the Black Lives Matter uprising, and it happened during Occupy Wall Street in 2010. Hell, the cops were shutting down microwatt FM broadcast stations back in the 1990s, levying unreasonable fines and separating children from their families, for broadcasting news and information related to the struggle for Black liberation. (*Seizing the Airwaves: a free radio handbook*, 1998)

The 10 meter, 11 meter (a.k.a CB radio) and 12 meter bands have fallen out of favor in the last few years because we are currently in a time called the "solar minimum"* which means there are very few, if any, sunspots. The number of sunspots fluctuates on an

AX.25 protocol, it’s primarily used on VHF, although HF-APRS does exist.

FLsuite is a collection of free software programs which enable you to decode and transmit many other digital modes with various properties, such as RTTY, PSK31, FSK, THOR, Hell, and even CW. It’s also able to decode Weatherfax transmissions, which consist of maps and weather reports primarily intended for ships at sea. FLDigi is the main program and it has a lot of features.

NBEMS: The Narrow Band Emergency Messaging System is probably one of the easier digital systems to implement. In its simplest form, all you need is your radio and an Android device running AndFLmsg. Simply type your message in the app, hold your radio up to the phone speaker and press the PTT button while the encoded message plays over the speaker. This method is called "audio coupling". NBEMS consists of many modes that would be suitable for different situations and preferences. And like Winlink, it also supports forms, as well as images.

Ribbit/Rattlegram is another program currently under development by the Open Research Institute that is pretty similar to AndFLmsg, except that it is a new protocol in and of itself which leverages Orthogonal Frequency Division Multiplexing to increase the density of information transmitted in the same amount of bandwidth.

There are too many digital modes to cover. But due to a recent FCC rule change (which was about 40 years

JS8Call is a mode that actually uses the same protocol as FT8, with the difference being that the program is actually set up for conversation, and messages can be stored and forwarded by intermediate stations. Like FT8, JS8Call depends on synchronized time sources such as NTP or GPS. However, it is also possible to adjust a time offset within JS8Call by tuning to the nearest FT8 frequency and making the adjustment.

While much hay has been made of how useful JS8Call *might be* in a “grid down” scenario, **Winlink** email has actually seen some action as a tool used in disaster relief efforts after hurricanes, tornadoes, earthquakes, and forest fires. The main thing that makes Winlink useful is its flexibility. Emails can be sent peer-to-peer, purely over the Internet, or it can even bridge the gap between on-grid and off-grid users by sending emails to and from normal everyday email addresses. The thing about The Grid is that there is no THE Grid, and it never goes down all at once. Another feature of Winlink that has made it useful in disaster relief is support for standard forms for different purposes such as damage assessment, medical reports, and general situation reports. Custom forms can also be created. Several Winlink client programs exist including Winlink Express (Windows), Pat (Linux, Mac), WoAD (Android), and RadioMail (iOS).

APRS is the Automated Packet Reporting System. APRS is a more or less global network that can be used for GPS coordinates, weather reports, bulletins, announcements, chat messages, satellite contacts, etc. With the use of “Igates” (internet gatways) it is even possible to send emails and SMS text messages using APRS. Using the

approximately 11 year cycle. This matters because the Earth's electromagnetic field responds to increased solar radiation by increasing geomagnetic activity. This allows radio waves within certain frequency spaces (such as the 10 meter band) to "skip" off the thicker ionosphere and be heard beyond the horizon or "line of sight". Skip propagation is a nearly constant feature of the 20 meter band, but using it in the US for anything other than Morse Code requires a General Class license and the equipment can be considerably more expensive. The "Citizen's Band" (CB) Requires no license to operate.

*__This was true__ when it was first written in 2020. However, if you are reading this between years 2023 and 2028, you are in the solar maximum and it’s probably a great time to get on 10 meters or CB.

If you want to get a license here are some things you should know:

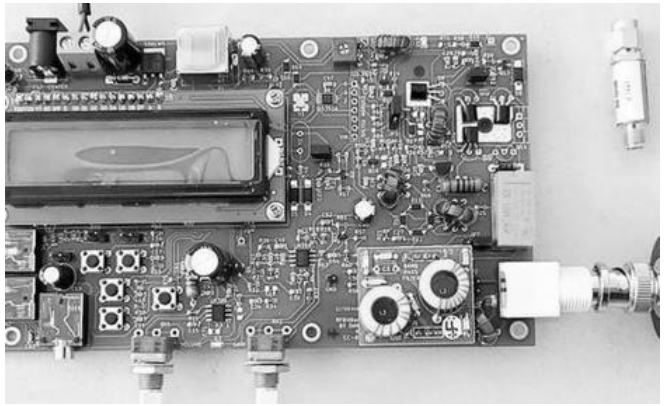
- **The FCC license database is PUBLIC**. It includes government names and addresses, and it’s very easy to search. If you want to get a Ham radio license, WE HIGHLY SUGGEST that you use a P.O. Box or an address that is not yours, but where you can check the mail. If you can’t afford one, share with comrades, friends, or family.

- There are 3 tiers of Ham radio licenses: From lowest to highest they are Technician, General, and Extra. The Tech license is 35 multiple-choice questions chosen out of a pool of 428 questions,

and you pass with a score of 74% or higher. Here's the trick: The questions and answers are all public. Take practice tests. https://hamstudy.org is a good tool. Use the Study Mode to answer questions one right after the other continuously. The site will keep track of your average score. After that, take some practice tests. You don't need to shoot for perfection. If you take the test multiple times and can consistently pass with 75-80%, you're ready to take the real test.

- Traditionally, you would have to be tested in person by volunteer examiners (VEs) and Volunteer Examination Coordinators (VECs) who have at least General class licenses. Usually they are members of an ARRL-affiliated amateur radio club. Because of the COVID-19 pandemic, most testing has moved online. If you test remotely, the requirements may vary a little in terms of how strict they are. My first test was administered over Zoom. I had to have my laptop camera on my face, and my smartphone camera over my shoulder to show my hands and my screen. Before the test I had to give them a tour of my room to make sure there was nothing in the room that I could cheat with. It's all pretty asinine, but it only took a few minutes and I passed.

    1. Before the pandemic, I was intimidated by the idea of going to a building, or possibly someone's home, with an Old White Man whose political beliefs may include the belief that I should be dead for whatever reason. If



RFbitbanger

Digital Modes

We've already mentioned digital voice (DV) modes a few times, but we have hardly given any space to...well, *digital modes* – basically, transmitting text over radio. In order to use these modes, you will usually need a computer, a radio, and a USB soundcard such as a DigiRig or SignaLink if your radio does not have one built in. Setups vary heavily depending on the equipment you're using.

The single most popular digital mode right now is called **FT8**. It's a time-synchronized "weak signal" mode in which people send a simple exchange of callsigns, gridsquares, and signal reports in 15-second increments. While this may not seem like the most useful thing, it is a very good way to test your HF radio setup and get an idea of the current band conditions, so that you can make adjustments. Programs for this mode are called WSJT-X

Sometimes you can find a good deal on used equipment and old radios (aka “boat anchors”) for pretty cheap. Check out auction sites, estate sales, and hamfests.

Kenwood TS-830s

(tr)uSDX

There are also a lot of small QRP (low power) kit radios that you solder together yourself. Many of them cost around $100 or less.

QMX transceiver by QRP-Labs

this is you, you may feel more comfortable taking advantage of remote testing.

2. With 1 in mind, remember that the VEs and VECs are *volunteers*. They are excited about the hobby and they want people to pass.

3. With 1 and 2 in mind, it would be extremely good of you to get your General class license after you get your Tech, and get trained as a VE so that you can administer tests to your comrades who may otherwise put themselves at risk in an in-person testing scenario. Be there for your queer, disabled, neuro-divergent, and BIPOC comrades.

- As of 2007, you no longer need to learn Morse Code to pass the exam. So don’t worry about it.

- As of April 19, 2022, the FCC charges a $35 application fee, which is very widely believed to be nothing more than a petty cash-grab by the federal government. Nevertheless, VECs usually waive the $15 exam fee they used to charge before this rule took effect.

Ex-prisoners

People in the US who have been convicted of a felony are required to answer a question about their conviction when applying for an amateur radio license.

When the FCC receives an application with the felony question answered “yes”, they automatically put the application status on pending. You have 14 days to send your explanation. The explanation is separate and in addition to the license application. The ARRL submits your application, but not your explanation. Write a description of your felony, stress that you have served your sentence, and list all the good things you have done since. You can request confidentiality. If you don’t request confidentiality, your application and it’s pending status will be posted on-line. - https://jobsforfelonsonline.com/can-a-felon-get-a-ham-radio-license/

According to a 2017 study, about 61% of applicants who answered “yes” to the felony question ended up being approved for their new license or renewal. 12% of the applications were dismissed due to the application being filled out incorrectly, or due to the applicant not sending an explanation within the 14 day period. 13% of the flagged applications that remain pending (they never seem to “deny” applications, only keep them in “pending” status perpetually) are from applicants who have been convicted of sex crimes. There is no way to know exactly what the FCC’s criteria are for dealing with flagged applications, but we can look at some of the results. (https://drive.google.com/file/d/1jg7YsAFlGAnUK6Rqs9LA_1ZHWpDITow2/view)

Analyzer. A traditional, lab grade VNA can cost thousands of dollars. The NanoVNA costs around $50, and it’s actually more useful for building impedance transformers and RF filters, as well as whole antenna systems, than a single-purpose antenna analyzer.

HF Radios

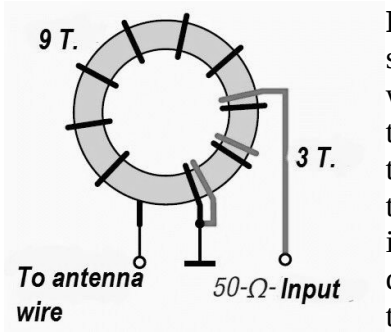
There are a lot of HF transceivers out there, and there’s not exactly a Baofeng equivalent, by which we mean cheap, ubiquitous, and *good enough.* There’s a ton of variation, and preference is very personal.

Yaesu FT-897 (100 watts max)

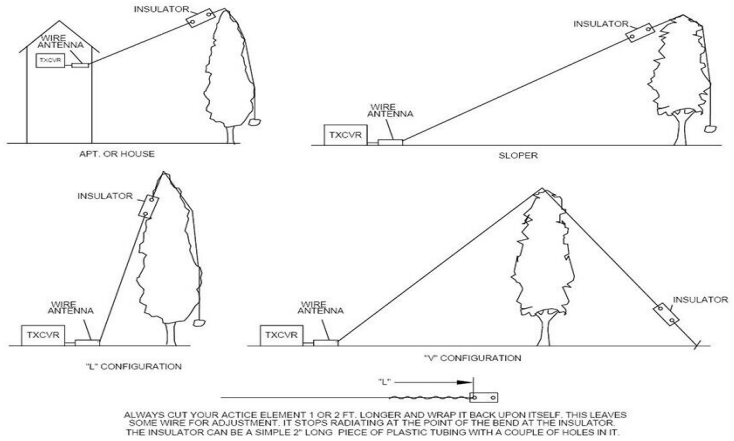
Lab599 TX-500 (10 watts max)

Xiegu G90 (20watts)

Above are a few examples of HF transceivers of various costs and quality. The cheapest of these is the Xiegu G90 which sells new for around $450.



Random Wire: Very similar to the end-fed half wave antenna in the sense that it is a long wire fed at the end by an impedance transformer. The difference is that the wire is deliberately cut to a length that is *not resonant on any band*. Usually fed with a 9:1Unun, this antenna requires a tuner such as an ATU-100, the tuner built into the Xiegu G90 radio, a manual tuner that you can DIY, or like several made by MFJ.


INSULATOR
WIRE ANTENNA
TXCVR
APT. OR HOUSE
SLOPER
"L" CONFIGURATION
"V" CONFIGURATION
"L"
ALWAYS CUT YOUR ACTICE ELEMENT 1 OR 2 FT. LONGER AND WRAP IT BACK UPON ITSELF. THIS LEAVES SOME WIRE FOR ADJUSTMENT. IT STOPS RADIATING AT THE POINT OF THE BEND AT THE INSULATOR. THE INSULATOR CAN BE A SIMPLE 2" LONG PIECE OF PLASTIC TUBING WITH A COUPLE OF HOLES IN IT.

Here’s a good webpage about random wire antennas. https://udel.edu/~mm/ham/randomWire/

If you’re going to build DIY antennas, especially HF antennas, there is an essential tool called an Antenna Analyzer. Purpose-built antenna analyzers can be pretty expensive, but there is an open source hardware device called the NanoVNA. A VNA is a Network Vector

In short, it is entirely possible for an ex-prisoner to get an amateur radio license. It does happen, and it only costs $35 to try. However, if you'd rather not engage with the state in this way due to carceral history, or any reason for that matter, there are still ways to engage in radio communication for tactical and emergency situations, or for just keeping in touch with friends and family.

License Free Radio

CB - The "Citizen's Band" is a set of 40 designated channels on 11 meters between 26.965 MHz and 27.405 MHz that are free for anyone to use without a license. With a legal power limit of 4 watts, an antenna mounted on the roof of a car, and in the absence of skip propagation, you can expect to have a range of about 10 miles. Before cellphones, CB radios were popular in rural areas. Houses and tractors would both have CB radios so that relatives could keep in touch with each other during the work day. School buses would also have CBs to let families know when the bus was arriving so parents would be notified when their children should leave for school.

Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.	Ch.	Freq.
1	26.965	9	27.065	17	27.165	25	27.245	33	27.335
2	26.975	10	27.075	18	27.175	26	27.265	34	27.345
3	26.985	11	27.085	19	27.185	27	27.275	35	27.355
4	27.005	12	27.105	20	27.205	28	27.285	36	27.365
5	27.015	13	27.115	21	27.215	29	27.295	37	27.375
6	27.025	14	27.125	22	27.225	30	27.305	38	27.385
7	27.035	15	27.135	23	27.255	31	27.315	39	27.395
8	27.055	16	27.155	24	27.235	32	27.325	40	27.405

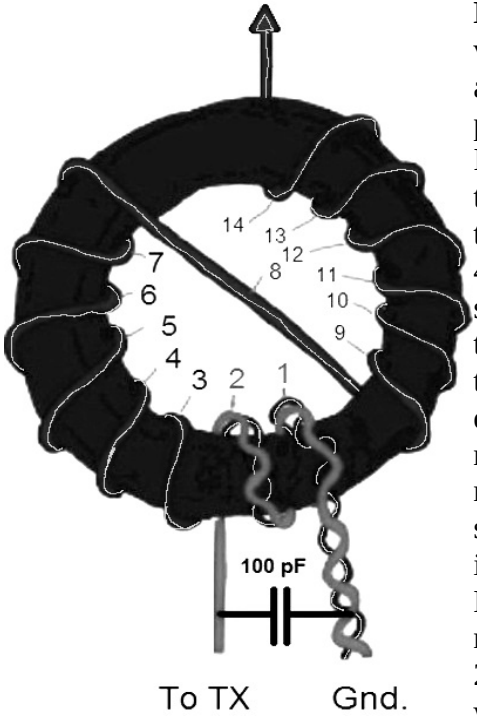
MURS - The "Multi-Use Radio Service" is similar to CB in that anyone can use it. MURS consists of 5 channels on the VHF band. With a power limit of 2 watts, depending on antenna size and placement, you can expect a range of about 10 miles.

CHANNEL	FREQUENCY	BANDWIDTH	NAME
1	151.82 MHz	11.25 kHz	MURS 1
2	151.88 MHz	11.25 kHz	MURS 2
3	151.94 MHz	11.25 kHz	MURS 3
4	154.57 MHz	20.00 kHz	Blue Dot
5	154.60 MHz	20.00 kHz	Green Dot

FRS - The Family Radio Service is a set of 22 UHF frequencies between 462.5625 MHz and 462.725 MHz. FRS radios are very common. They are the most likely type of radio you'll see sold in stores. They have specific requirements to be legally sold as FRS radios in the US. Namely, they can't operate at higher than 2 watts, they can't be programmable from the front display, and they can't have a detachable antenna. While this is currently not enforced, that may change at any time in the future, and it's good to be aware.

GMRS - The General Mobile Radio Service is a set of 30 frequencies on the UHF band between 462.5625 MHz and 467.725 MHz. 22 of those frequencies are shared with FRS, but an FRS radio is only allowed to operate at up to 0.5 watts, as opposed to up to 50 watts with a GMRS license. The license costs $35, and applies to every immediate family member. You don't have to take a test to get a license. Just file an application with the FCC. What's

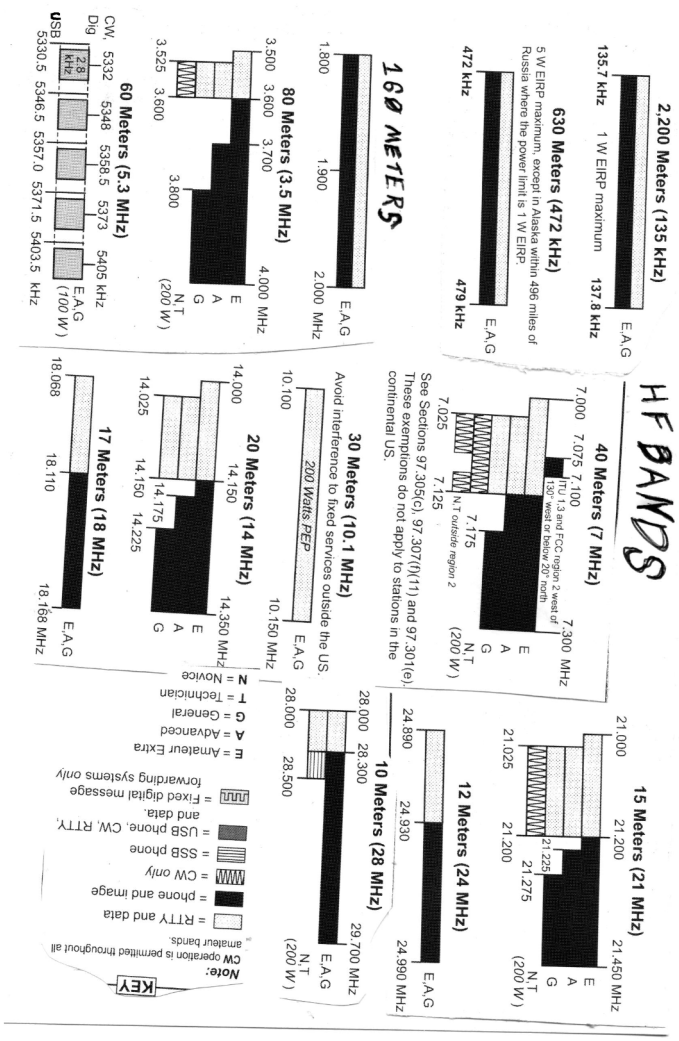
HF antennas



49:1 Unun. You can make one yourself, but they are also available online for pretty cheap.

Parts: 240-43 toroid, 2x strands of enameled copper wire, 100pF 10KV capacitor

End-Fed Half Wave: A very versatile antenna, and one of the most popular in recent years. It's one long wire fed at the end by an impedance transformer (usually a 49:1 Unun but sometimes a 64:1 Unun) the transformer connects to the radio either either directly, or via a short run of coax cable. The major benefits of this style of antenna are **1)** it's multi-banded. An EFHW antenna for 40 meters is a full wave on 20, ¼ wave on 80, and it will also usually give you one or more of 15, 12, and 10 meters. **2)** It's resonant, so you don't need an external antenna tuner. **3)** It's portable. The EFHW is very popular as a portable antenna because the single long wire can be wound up on a spool or wire winder, packed in a backpack and deployed quickly.



Oooh! It's a cut-and-paste diagram of what the rules are. How very punk rock of us. /s

the point when you can just use the frequencies and not get licensed? Aside from the chance you'll get fined by the FCC, we don't know. Take the risks you're comfortable with.

Channel	Frequency (MHz)	FRS max pwr (watts)	GMRS max pwr (watts)
1	462.5625	2	5
2	462.5875	2	5
3	462.6125	2	5
4	462.6375	2	5
5	462.6625	2	5
6	462.6875	2	5
7	462.7125	2	5
8	467.5625	0.5	0.5
9	467.5875	0.5	0.5
10	467.6125	0.5	0.5
11	467.6375	0.5	0.5
12	467.6625	0.5	0.5
13	467.6875	0.5	0.5
14	467.7125	0.5	0.5
15	462.55	2	50
16	462.575	2	50
17	462.6	2	50
18	462.625	2	50
19	462.65	2	50
20	462.675	2	50
21	462.7	2	50
22	462.725	2	50

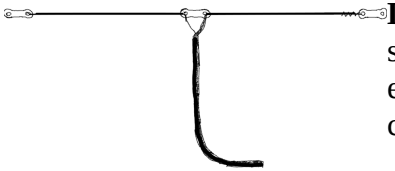
Antennas

An antenna is not just a wire. This is especially true when transmitting. If you're just receiving, you have a lot of leeway when it comes to the antenna. But when you're transmitting, the antenna has to be tuned in resonance with the frequencies you're trying to transmit on, or else your signal is going to be very bad, or you could even damage your radio. Different types of antennae have different propagation characteristics and different applications for different situations. Antenna theory is probably the single most interesting aspect of amateur radio and you can make a lot of them yourself.

The length of an antenna is usually equal to 1/4 wavelength because of resonance. It's usually the most efficient in terms of material and overall effectiveness. There are a lot of exceptions to this rule, but a 1/4 wave antenna is by far the most common VHF/UHF antenna.

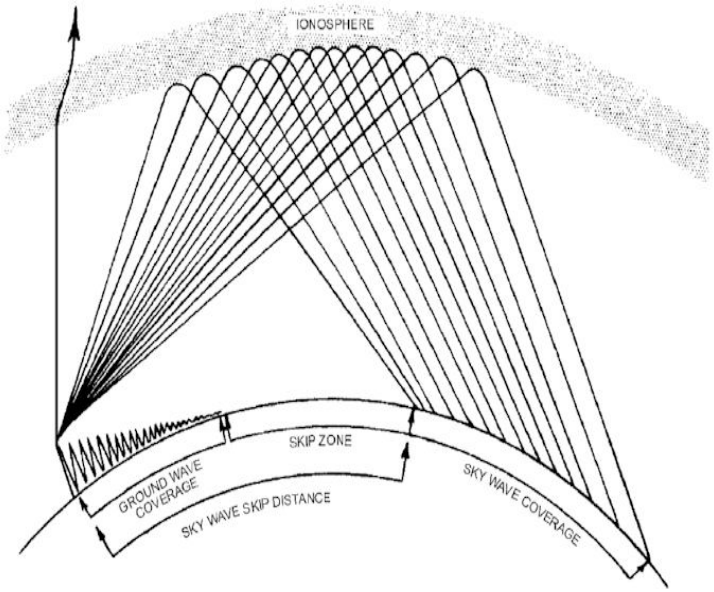
Whip or monopole - an extremely common type of antenna. The type that you see on cars, or that come with an HT or walkie talkie.

"Rubber duck" - is a name for the antenna that comes with your handheld radio. It's usually not a very good antenna.



Dipole - two wires of the same length extend from the end of a piece of coaxial cable. One wire is attached

When you get on HF, you really start to get a sense of what needs to be done to build an autonomous communications infrastructure. You learn to move with space weather. You'll find that you can reach some stations better during the nighttime than by day and vise-versa. Some bands will reach farther in the winter than in the summer. You'll also find that some contacts can't be made by voice or by data, and only Morse code (CW) can cut through the noise. You'll learn that a radio is not a telephone, and that only when the conditions are just right can you reliably contact the persons that you want to.

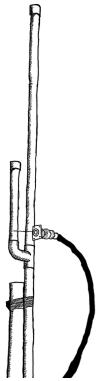


where it's at. The frequencies between about 3 MHz and 30 MHz actually bounce off of the Earth's ionosphere, rather than going through it or being absorbed by it.

In the so-called-US, HF really opens up for you when you get a General class amateur radio license. Other countries such as the UK have different licensing schemes in which the different license classes put a limit on the amount of power you're allowed to use, rather than what frequencies you're allowed to use. The good news is that the amount of power really only changes the ease with which certain contacts can be made. Some modes are more efficient than others, but the magic is all in the antenna and your skill as an operator.

to the center wire of the coax, and the other is attached to the outer shield.

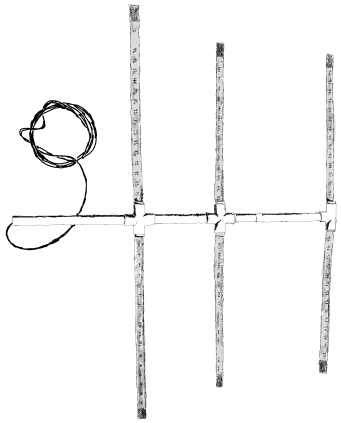
Ground plane - usually 5 wires of the same length, equal to 1/4 wavelength. (i.e. if it's intended for the 2 meter band, the wires will be approximately 50 Centimeters) One wire is attached to the center conductor of the coax cable, and the other 4 are connected to the ground shield.



J-pole - usually made from copper pipe, it's popular because of it's durability and relatively high gain. The long section is ¾ wavelength and the short section is ¼ wavelength. So if tuned to the 2 meter band, it would be approximately 1.5 meters and 50 centimeters respectively.

Slim Jim - Often made from "ladder line" and can be rolled up and carried in a backpack. To use the antenna, attach to a rope and throw it into a tree for better altitude. Propagation characteristics

are similar to that of a J-pole, except with the main benefit of being portable.



Yagi-Uda – A directional antenna consisting of a dipole as the “driven element” along with two or more “parasitic elements” placed at specific distances apart from each other along an insulating boom. Yagi antennas can be used to locate the source of a signal or interference, as well as direct a transmission in a more focused “beam”. Dual band Yagi antennas are also used to make satellite contacts. A 2m/70cm Yagi made out of a tape measure and pieces of PVC pipe is a common DIY antenna project.

Notes on Encryption

In the United States, it is illegal on the amateur spectrum to "transmit messages encoded to conceal their meaning".

Of course, this only applies to poor people and people who don't run large tech corporations. https://www.amateurradio.com/encryption-is-already-legal-its-the-intention-thats-not/ But you know, c'est la vie under Capitalism.

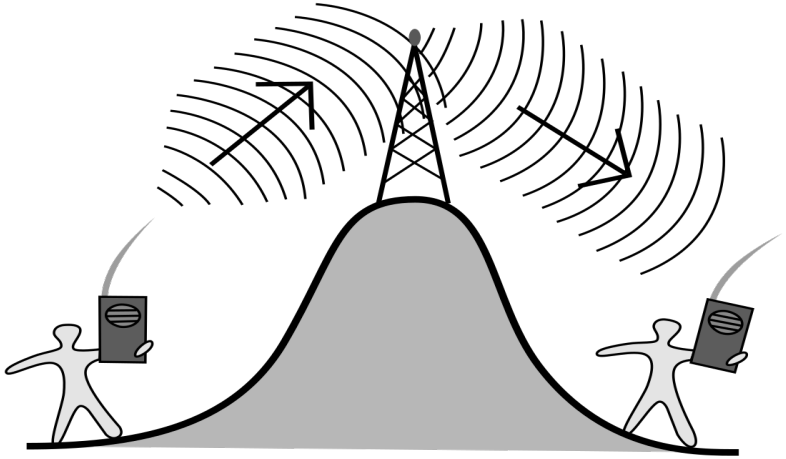
For example, if you hear a repeater on 145.00 MHz and someone on there says it has a positive offset of 0.6 MHz, you'll know that the uplink frequency is 145.00 plus 0.6 which is 145.6 MHz. You can program that into your radio and start talking to people.

Most repeaters will also have a CTCSS tone, at least on the uplink frequency, in order to avoid receiving transmissions that are not intended for the repeater.

It is possible to build your own repeater for relatively cheap. Building a portable repeater into an ammo can is a popular project.

HF for Long Distance Communication

If you want to talk to someone beyond line-of-sight, say in the next state or even in another country, the HF bands are



A repeater is a radio that receives a signal and re-transmits it to extend transmissions so they can cover longer distances or be received on the other side of an obstruction such as a mountain. They are usually placed as high up as possible in order to get the best possible coverage. Most cities of at least a few thousand people have at least one repeater. A lot of people like to think of them as "watering holes" or "chat rooms" for local hams.

A repeater is usually a receiver connected to a transmitter. The output of the receiver is connected to the input of the transmitter and the two are tuned to different frequencies. The frequency that you transmit *to* the repeater is called the "uplink" frequency, and the one that you receive *from* the repeater is called the "downlink" frequency. The difference between the two frequencies is called the "offset" and it's either "positive" or "negative" depending on whether the downlink is at a higher or lower frequency from the uplink respectively.

It is possible to use digital modes to *effectively* encrypt* your transmissions, but it depends on your threat model. If the people you're trying to avoid detection from aren't set up to receive simplex DMR transmissions for example, then there's less chance of your messages being intercepted by cops or fascists. These sorts of things increase the barrier to entry to ham radio in terms of money, but it's good to know what's out there and get planning.

*not actually encrypt, but to digitally encode.

A note on obscure bands: There are some bands that just don't get used as much as others, for any number of reasons. The main one that comes to mind is the 1.25 meter band, a.k.a. 220 MHz. It's odd that it's used so little, considering that signals seems to travel through walls better than the 70 cm band. The most likely reason for 220's unpopularity is that manufacturers simply don't make a lot of 220 transceivers. Capitalism's usual chicken-and-egg problem. (The Baofeng UV-5RX3, Wouxun KG-Q10H, and Yaesu VX-6 are a few tri-band handheld radios that include the 220 band.)

6 meters (~50 MHz) is another less popular band. Often called "the magic band" because ionospheric conditions will almost randomly change in such a way that communications open up for hundreds or even thousands of miles. Most of the time, however, the 6 meter band has a local reach of about 10 miles.

"Security by obscurity" is nobody's favorite opsec philosophy, but at times it may not be totally worthless. Keeping messages short, using the least power necessary to make the contact, making sure the radio is spectrally pure and not splattering all over harmonic frequencies (Baofeng and other cheap handheld radios are notorious for this), and using directional antennas are other things to consider if trying to keep the source of transmissions from being discovered. There is NO silver bullet.

Legal Bullshit

Unless you have an amateur radio license, it is technically illegal to transmit using a Baofeng UV-5R (or similar radio) in the US under almost every circumstance. There are even circumstances *as a licensed ham* where it's illegal to transmit using one of these radios, such as if you were to transmit "out of band".

Baofengs are illegal to use on FRS frequencies because you can program them using the number pad on the front of the radio, they have swappable antennae, and they transmit at 3 watts higher power than FRS is allowed, EVEN IF you have an amateur radio license.

People who do not have an amateur radio license are not *legally* allowed to transmit on FRS frequencies using non-FRS-compliant radios. In regards to Baofeng and similar radios, this law has so far not been enforced. My totally unfounded opinion is that there are so many people in the US who have gotten hold of these radios and programmed

> *rather significant at VLF and ELF frequency bands. In certain cases, by using high power and very low frequency (VLF) transmission, radio waves can be made to encircle the earth only by exploiting the principle of diffraction.* ~ https://vu2nsb.com/radio-propagation/radio-propagation-fundamentals/

The **Power** of your radio is also a factor in determining the distance you'll be able to transmit on a given frequency at a given height. Higher wattage *will* increase your range, but to the best of our knowledge, because there are so many factors involved there is no formula or reliable way - other than field testing - to determine how the range improves. IT'S NOT INSIGNIFICANT. If you can upgrade from a 1/2 watt FRS radio to a 5 watt HT, or to a 25 watt or higher mobile rig, your range *will increase significantly.*

Your **operating conditions** can not be ignored. If you're at a protest in an urban environment with lots of steel and concrete around, UHF may be your best option for keeping in touch with your affinity group. If you're in the exurbs or if you're in a woodland, desert, marine, VHF will probably be more effective.

Repeaters

We've already mentioned repeaters here a few times, but this is a convenient spot to explain what they are.

tendency to bend around the obstacle. The bending, called diffraction, resulting in a change of direction of part of the radio wave from the normal course of propagation. This makes it possible to receive radio signals around the edges of an obstacle. Although a diffracted radio signal is usually weak, it can still be detected by a suitable receiver. The phenomenon of radiofrequency diffraction is predominantly noticeable during radio communication conducted in a hilly terrain especially in the VHF or UHF bands.

A radio transmitter on the other side of a hill with no direct line-of-sight access can often be copied and communication can be established. Of course, other phenomena like scattering from other nearby topological artifacts also contribute to such types of communication but diffraction over or around the hilltop is one of the predominant factors. This is referred to as the Knife-edge diffraction phenomenon.

Another important effect of diffraction is its contribution towards extending the radio range beyond the visible horizon. Due to the extended range that is possible on account of diffraction, the Radio Horizon tends to extend beyond the optical horizon. This is not predominant and may play only a small role at HF, VHF, or UHF since other effects like atmospheric super-refraction, surface-wave propagation, etc usually overshadow the effects of diffraction. However, diffraction becomes

them with FRS channels, the law is more likely to change before it's enforced in its current state.

The takeaway is this: don't be irresponsible. Know the risks, don't get caught. **Nothing in this entire document should be considered legal advice.**

Anyone can listen But not everyone is allowed to transmit.

At least in the so-called United States, the amateur radio bands have been very popular with "preppers" and Right-wing reactionaries for decades. Despite the fact that everything they say is sent in the clear for anyone to hear, and all licensed amateurs *take a test that tells them this, and pass it*, some of these chuds think ham radio is "tactical" and it's therefore safe to say some racist shit.

This, and the fact that the FCC amateur license database is publicly accessible with legal names and addresses, may mean that it's a good idea to learn your way around the radio waves in your area in order to gather a few more data points for community self-defense.

If you only want to listen, we would recommend finding one or both of 2 items:

1: RTL-SDR or other SDR. SDR stands for "Software Defined Radio". It's a USB device that you plug into your computer and you can tune it using a program like SDR# ("SDR sharp") or GQRX among others to listen to what's happening on various frequencies. These can be found

online for fairly cheap (around $20) and they are often sold as "TV tuners" because people use them to watch over-the-air television on their computers. There are even SDRs that can transmit, such as the HackRF One, but they are considerably more expensive. The HackRF One is currently selling for $340.

2: Baofeng UV-5R, Quansheng UV-K5, or other VHF/UHF transceiver. Keep in mind that it is illegal to transmit on the amateur bands without a license unless there's an emergency. Keep a low profile and keep your wits about you.

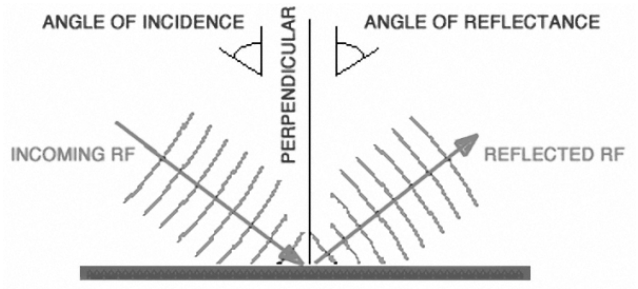
Repeaterbook.com is a website that will help you find repeaters local to your area.

CHIRP is a program that allows you to program channels and frequencies into Baofeng radios and other types of radios as well. (Not relevant if you're using SDR to listen)

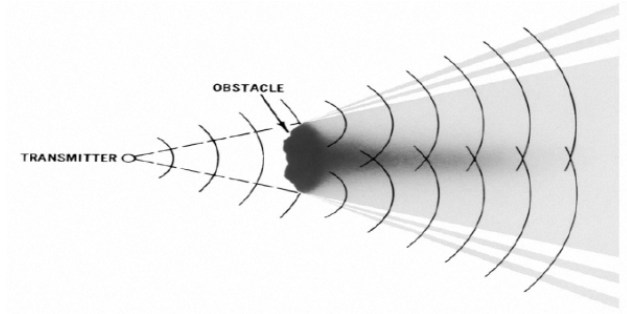
- COMRADELY TIP: Use CHIRP to build a list of frequencies that are relevant to your area. This should include frequencies for your affinity group to use, repeaters, emergency frequencies, and possibly even any SSTV or APRS frequencies you decide to set up for whatever purpose you see fit.

IMPORTANT PRIVACY TIP: If you are going to get an amateur radio license, also get a P.O. box (or find a friend who has one) and list it as your address on your application. The FCC doesn't really care where you live, just that they can contact you by mail.

The phenomenon of "knife-edge diffraction" makes it possible for radio waves to bend *around* a large obstacle and create an echo behind it, which, while it results in a weak signal, can extend the range of your transmission to as much as 9 miles.



radio wave reflection



knife-edge diffraction

When a propagating radio wave encounters an obstacle, its energy is reflected or absorbed, causing a shadow beyond the obstacle. (...) However, some energy does enter the shadow area behind the obstacle because of diffraction.(...)

A radio wave that meets an obstacle has a natural

Earth itself. Moreover, they pass straight through the ionosphere and into space instead of bouncing off and reflecting beyond the horizon. What this means is that in order to increase your signal range, you need to *increase the distance of the horizon*. This is most easily done by increasing the height of your antenna.

You can calculate the distance to the horizon in miles with these formulae:

√(1.5 x height of antenna in feet), or √(13 x height of antenna in meters)

So, if you're holding a handy-talkie up to your face to talk into it, and you're about 6 feet tall, and there's not a whole lot of stuff between you and the radio you're trying to reach, your effective range is about 3 miles.

But if you have a roll-up J-pole antenna that you can throw onto a tree branch 10 feet up, that increases your range to almost 4 miles.

If you can put an antenna just on top of the roof of a 2 story house, you can increase your range to between about 5.5 and 6 miles. If you can put *that* antenna on a 10 foot mast, your theoretical range is 7.25 miles.

Mountainous or hilly terrain can be a problem, but it can also be used to your advantage. VHF and UHF have the ability to reflect off of vertical features and redirect the RF energy in a different direction, behind an obstacle.

"Privacy Tones"

Most modern radios come equipped with settings called CTCSS and/or DCS. Sometimes these are called "privacy tones" due to Motorola first introducing it as "PL Tone" or "Private Line Tone".

Possibly the most important thing to remember about "privacy tones" is that they are NOT PRIVATE. They do not encrypt or scramble your transmissions in any way.

Privacy tones use a technique called "squelch". Squelch turns off a receiver's audio output until the received signal exceeds the squelch level. Noise squelch is used to suppress background noise and static. The level is user adjustable and it's designed to prevent listener fatigue.

CTCSS stands for "Continuous Tone Coded Squelch System". What it does is transmit a sub-audible tone from your radio that other radios programmed with the same tone will listen for, and open up the squelch allowing you to hear the transmission. This is the most common type of privacy tone. Most repeaters require a CTCSS tone for access. There are 50 standardized CTCSS tones.

DCS stands for "Digitally Coded Squelch" and works on the same principle as CTCSS, except that the sub-audible tone is replaced with a 3 digit code that is sent as a 23 bit binary word sent using FSK (Frequency Shift Keying) continuously at about 134 bits per second. Your receiver will automatically use filtering to prevent audible noise. There are 512 possible DCS codes. Polarity can be

inverted so that all 'zeros' become 'ones' and all 'ones' become 'zeros', and there's no good way to detect if a radio is doing this.

As we said earlier, anyone can *listen* to your transmissions. But using CTCSS or DCS can prevent people from breaking into your conversations and causing interference or feeding false information.

When making a choice between CTCSS and DCS, like a lot of tactical decisions, it's good to come up with a threat model.

One threat model: Someone is monitoring radio traffic in a van using an SDR during a protest. They can monitor multiple frequencies at once by looking at a waterfall display, and they can tune to a frequency that is active and start listening.

If that person wants to try and jam your frequency or feed us false information, they would have to identify the tone we're using. It would be easier to pick out a CTCSS tone because it's constant, there are only 50 of them, and you can see it on a waterfall display.

With DCS on the other hand, it would be difficult to pick out visually on a waterfall display, there are 512 possible tones, and there's no easy way to tell if the polarity is positive or negative. This is why we recommend using DCS on your radios.

"So how far does this thing reach?"

It's a simple and common question with a sometimes disappointingly complex answer: "it depends." Radio waves travel at the speed of light. (Just let that sink in for a second, because it's really cool. You are talking *with invisible light!*) In outer space, radio waves go on forever or until they hit something they can't pass through. But Earth is not a vacuum.

The distance that a signal can reach depends on three main factors: Frequency/Wavelength, Antenna Height, Power, and operating conditions.

Frequency* is measured in Hertz. 1 Hertz(Hz) is equal to one cycle per second. Frequency and wavelength are directly correlated.

$\lambda = C/f$

λ = Wavelength in meters

C = Speed of Light (299,792,458 m/s)

f = Frequency

The **height of your antenna** is substantially more important than the power you're operating on. **VHF/UHF** radio communication is considered to be "Line of Sight" because, at frequencies above 30MHz, radio waves are unable to pass through large buildings, mountains, or the